Standard Sampling Grids for Avian Monitoring Programs - July 2013

Recommendations to US-NABCI from the US-NABCI Monitoring Subcommittee

Summary

To sustain healthy bird populations into the future, bird conservation practitioners can greatly benefit from a seamless national and international grid system. Use of standard methods and frameworks for data collection and/or data delivery can facilitate coordination and integration of data from monitoring activities and overcome some of the challenges created through the current use of arbitrary sampling locations and grid reference systems. These challenges pose an impediment to greater collaboration and data integration goals. The Military Grid Reference System (MGRS) and the United States National Grid (USNG) are existing standard location reference systems that are already being used in sampling designs and for reporting of data from avian research and monitoring activities.

Recommendations:

1) US-NABCI endorses the use of MGRS and USNG standard reference grids in avian monitoring programs and projects. The MGRS is recommended because it is global in spatial extent. The USNG, a conterminous U.S. bounded subset of the MGRS with a different datum, is also recommended for projects occurring entirely within the conterminous U.S. to simplify integration with other U.S. data sets.
2) US-NABCI endorses a shorter version of this document published in the All-Bird Bulletin.
3) Agreement by individual US-NABCI agency representatives to consult with members of the US-NABCI Monitoring Subcommittee about widespread implementation of the grid standards.

Background

In the 2007 report “Opportunities for Improving Avian Monitoring”, the United States North American Bird Conservation Initiative (US-NABCI) Monitoring Subcommittee identified the need for improving the utility, coordination, and efficiency of bird monitoring programs in the United States. Addressing this need was stated as a means to improve bird conservation delivery across a variety of spatial and temporal scales. There was also recognition that linking local monitoring and conservation actions to regional /national goals and outcomes remains an important challenge; a challenge that becomes more pressing with the increasing use of ecoregions and other broad landscape units as areas of scientific inference and for the delivery of conservation planning.

One approach to encourage coordination and facilitate the sharing and integration of data that result from cross-scale monitoring efforts is the adoption of scalable and standardized monitoring methods and frameworks. Use of standards at any point in the data collection, data management, or data dissemination stage promotes wider use and application of data in conservation. In recognition of the importance of standards, a compilation of best practices and standards for management of avian monitoring data was completed under the auspices of the U.S. NABCI Monitoring Subcommittee (Martín and Ballard 2010). Following on previous efforts to identify and promote the use of standards in monitoring activities, we describe in this document a location reference system that can potentially serve as a standard in sampling designs and the delivery of geospatial data.

Ecological data collection designs, especially those conducted over large areas, often involve sampling methods that subdivide an area into equal area units, resulting in grids of cells. These grids are then used to conduct systematic, random or stratified sampling of the area under consideration (e.g., Bart 2011) and can be spatially-joined with other datasets, such as watershed and refuge boundaries. Grid-based sampling designs, such as Generalized Random Tessellation Stratified (GRTS) survey designs (Stevens and Olsen 2004), are becoming increasingly popular with the U.S. Forest Service, the National Park Service, the Environmental Protection Agency, the U.S. Fish and Wildlife Service, and several bird observatories. If use of standard sampling grids becomes more popular in the design of bird population and habitat surveys, then there is an opportunity to realize economies of scale by practices that facilitate data sharing and integration efforts across project boundaries and over large landscapes.

Not using standard grids results in additional costs at various points of the data life cycle, including the repeated time and expense needed to generate grids during the development phase of each avian monitoring activity, as well as the cost of later attempting to combine existing data from activities that utilize different spatial references. One reason is because grids are often generated before or after data collections on a project-by-project basis using an arbitrary set of reference points and cell indexing system. Most geographic dataset products based on these arbitrary grids therefore require post-processing before they can be combined with other datasets. These costs are usually borne by the consumers of these datasets, especially those working to integrate datasets over areas larger than individual project areas. Furthermore, cells of arbitrary grids often do not spatially overlap or nest within each other, thus hindering the development of location-based services for these data. This lack of coordination may continue to restrict data sharing and use among organizations.

<u>Recommended Standard Grids</u>

Geospatially, grids provide a means to subdivide sections of the Earth into cells that can be hierarchically aggregated and described by location and area. Although various grids of differing cell size, spatial extent, and cell shape are in existence today, some of these grids may be better suited for use in avian monitoring. The long-distance migration of many bird species and regional/national conservation issues suggest that a most useful grid standard should have a national or hemispheric spatial extent, with cells that are nested and square-shaped in geometry, a common geometry used in ecological field sampling and remotely sensed imagery. A grid standard with these properties would facilitate comparisons of avian monitoring data across project areas and scales as well as data sharing among organizations.

In collaboration with staff from several organizations*, our group has identified two existing standard location reference systems, the Military Grid Reference System (MGRS) (National Geospatial Intelligence Agency 2006) and the MGRS-derived United States National Grid (USNG) (Federal Geographic Data Committee 2001, 2008), as having the qualities necessary for a standard grid to be used in ecological monitoring. *We therefore recommend that US-NABCI endorse the MGRS because it is global in spatial* *extent. However, the compatible USNG is also recommended for projects occurring entirely within the conterminous U.S. to simplify integration with other U.S. data sets.*

MGRS and USNG are naming systems commonly used as georeferencing standards by the military and emergency management in the United States. These systems are easy to use, and their grids have square cells, resolutions of up to 1-meter cells, nested cells with naming conventions based on multiples of 10 (e.g. 1, 10, 100, 1000 meters), and they are based on a coordinate system widely used by Global Positioning System receivers and on maps. MGRS has a global extent, while USNG covers the conterminous United States. They are both based on the Universal Transverse Mercator (UTM) coordinate system between latitudes 80°S and 84°N and report position as distance from the equator (Northing) and distance from the zone central meridian (Easting) following the convention used by the UTM coordinate system. MGRS and USNG differ in their datums (reference models that define the 3-dimensional shape of the Earth). MGRS uses the World Geodetic System of 1984 datum (WGS 84), while USNG uses the North American Datum of 1983 (NAD 83). When USNG is used with the WGS 84 datum, it is the same as MGRS; otherwise the offset between USNG and MGRS is about a meter, which is insignificant for most conservation applications. More information about the relationship of MGRS, USNG and UTM can be found in various websites (Federal Geographic Data Committee 2010, National Geospatial Intelligence Agency 2006, Studt 2011, Wikipedia contributors 2011).

Extensive documentation on implementation of USNG, considered a national standard in the United States, is provided by the Federal Geographic Data Committee (2010) at <http://www.fgdc.gov/usng>. USNG grids for the United States at a 1km-cell resolution are available from Delta State University (2011) at <http://mississippi.deltastate.edu/>. Use of USNG is preferred when using a grid reference system for an area that falls exclusively within the United States. Due to its global extent, MGRS provides a framework that can be used for data collection design and the sharing of monitoring data across all of North America and other parts of the world. MGRS grids for North America (Canada, Mexico, and the United States) at 100km, 10km, 1km and 100m-cell resolution are available from the University of Florida GeoPlan Center (2011) at <http://mgrs-data.org/>. These MGRS grids can be converted to USNG by applying in ArcGIS the NAD_1983_To_WGS_1984_5 transformation (Esri 2012) for use in areas within the contiguous United States.

Examples of MGRS and USNG use in biology and conservation range from sampling designs to data modeling and visualization. MGRS was used to derive a common grid for species distribution mapping across taxa in Europe (European Environment Agency 2003). This standard European grid has been used in sampling and presentation of biodiversity data from atlas projects (Finnish Museum of Natural History 2001), invasive species mapping (Hulme et al. 2009), and biogeographic studies (Heikinheimo et al. 2007). In Canada, MGRS has been used to derive sampling grids for the Ontario Breeding Bird Atlas (Ontario Breeding Bird Atlas 2001). USNG, which is a national implementation of MGRS for the United States, has been used to develop a sampling grid for monitoring birds in the Great Plains Landscape Conservation Cooperative (GPLCC) (Sparks et al. 2010). This USNG derived sampling grid for the GPLCC region will allow for coordinated bird monitoring and allow biologists to rescale the grid for monitoring a variety of taxa at multiple scales. These examples show that use of standard grids for sampling, aggregation or reporting of data can facilitate the integration and sharing of data from local to regional to continental and to global scales.

Adoption and implementation of standard grids for sampling and dissemination of avian monitoring data would provide for three important advances. First, it would provide a means to identify sampled areas in a consistent manner so that results of monitoring projects can be evaluated in a spatially comparable way. Second, and perhaps more important, the use of standard grids would allow for the integration of datasets and subsequent identification of areas where sampling should or has not occurred. And third, it would facilitate regional and national-level avian distribution modeling and the development of broad-scale avian distribution maps. We encourage the U.S. NABCI Monitoring Subcommittee to endorse the use of USNG and MGRS as standards for grid-based sampling designs and the dissemination of avian monitoring data in an effort to improve coordination, efficiency and utility of avian monitoring programs.

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